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THE IMPACT OF INFLATION ON STOCK MARKET RETURNS AND CONDITIONAL VOLATILITY: EMPIRICAL EVIDENCE FROM THE SAUDI STOCK MARKET

Key Words

Inflation; Stock Returns; Volatility; GARCH Models.

Abstract

This paper investigates the impact of inflation on stock market returns and volatility using monthly observations of inflation rate and general stock market index (Tadawul) for the Kingdom of Saudi Arabia over the period from January 1990 to December 2011. The empirical analysis of the paper is carried out by means of the Generalized Autoregressive Conditional Heteroscedastic (GARCH) methodology including both symmetric and asymmetric models. Based on AR-GARCH (1,1) and AR(1)-EGARCH(1,1), the results show that there is no significant effect of inflation rate on the conditional mean equation representing the monthly stock market returns. But, when including the inflation rate into the conditional variance only and on both mean and variance equations, the results indicate a significant positive effect.

Introduction

The relationship between stock market returns and inflation has long been a topic of considerable interest for academics, monetary policy makers, investment professionals and almost all those have something to do with the stock markets. A clear understanding of this relationship is of crucial importance for all market participants, since it quantifies the degree to which equities are a hedge against inflation risk. For example, this will help investors in the stock market to make good portfolio decisions based on their knowledge of past economy and expectations about future.

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Theoretically, it is generally accepted - until the early 1970s - that the relationship between inflation and stock market returns or prices was positive. This was based on Fisher hypothesis (1930) who postulated that stock markets are independent of inflation expectations, implying that prices and inflation should move in the same direction. This is attributed to the fact that the expected nominal return on equities consists of two components, the real return and the expected inflation rate. The generalized Fisher hypothesis, or effect (Note 1) states that equities are a claim against real assets of the company and can serve as a hedge against inflation. When inflation is pronounced, investors would sell financial assets in exchange for physical or real assets such as stocks. If that takes place, the price of equities should reflect fully the expected inflation, and the relationship between the two variables (inflation and stocks or equities) should be positive. However, after the late 1970s it was found that the relationship between stock market prices and inflation can also be negative which contradict Fisher's (1930) hypothesis. For example Fama (1981) disagreed with the generalized Fisher hypothesis and suggested that stock markets or equities were not a hedge against inflation. The relationship between inflation and stock market returns operates through the impact of the expected changes in real output on the general price level (Note 2). According to Fama, the negative association between stock market and inflation results from the relationship between inflation and future output. An increase in inflation causes uncertainty and reduces future economic activity. The returns on the stock market reflects future earnings of the firm, and an economic decline predicted by an increase in inflation will cause a reduction of stock price, hence the relationship between stock market prices and inflation is negative.

Since then, there has been an extensive empirical literature that examines the relationship between stock returns and inflation for both developed and emerging stock markets over a range of different time horizons. Contrary to the Fisher (1930) view, several studies document that stock returns and inflation are negatively correlated (Note 3). For example, Linter (1975), Fama and Schwert (1977), Fama (1982), Geske and Roll (1983), and Caporale and Jung (1997) for US financial market and Wahlroos and Berglund (1986) and Asprem (1989) found a significant negative relationship for some European markets. Chatrath and Ramchander (1997) and Hu and Willett (2000) provide evidence for Indian stock market and Spyrou (2001) for Greece. On the other hand, Cagan

(1974) found a positive relationship between common stock returns and inflation for several countries between 1939 and 1969. Also, Choudhry (1998) found a significant positive relationship for four high inflation countries (Argentina, Chile, Mexico and Venezuela). Explanations of negative (or positive) relation can be found as in Hess and Lee (1999) who showed that the relationship between stock returns and inflation can be either positive or negative, depending on the source of the inflation in the economy. They concluded that the negative stock returns-inflation relationship is due to supply shocks which reflect real output shocks while the positive relationship is due to demand shocks, are mainly due to monetary shocks. However, some empirical investigations provide no significant relationship between the two variables as in Pearce and Roley (1985) and Hardouvelis (1988). Recently, the issue has been extensively investigated across different regions and countries see for example; Campbell and Vuolteenaho (2004), Gan, et al. (2006), Saryal (2007), Duari and Bhaduri (2009), Alagidede and Panagiotidis (2010), and Tarika et al (2011). Campbell and Vuolteenaho (2004) confirmed the negative relation by suggesting that stock markets suffer from massive inflation illusion. Gan et al. (2006) report that the New Zealand's stock market index (NZSE40) among other macroeconomic variables tested, is cointegrated with Consumer Price Index (CPI). Duari and Bhaduri (2009) suggest negative relationship. Alagidede and Panagiotidis (2010) show that the stock market tends to provide a hedge against rising consumer prices in some African markets. Based on analyzing stock portfolios rather than single stocks Tarika et al. (2011) revealed that the inflation rate among other variables have a negative relationship with returns for portfolios of big and medium companies.

For the case of the Saudi stock market, Mofleh (2011) investigates the long run and short run relationships between Saudi stock market returns and eight macroeconomic variables. Among these variables he found a significant negative relationship between stock market returns and the inflation rate defined by the consumer price index (CPI). One possible implication of this result provided by Mofleh was that the Saudi stock market is not an effective hedge against inflation; hence investments probably would shift to the real assets from a risky stock market when the inflation rate is very high.

Given the two stylized facts that characterize financial time series, i.e., volatility clustering (Note 4), and a leverage effect (Note 5), the assumption of homoscedasticity (Note 6) is often not satisfied. Therefore, tradi-

tional econometric techniques (like ordinary least square; OLS) are not adequate. Well-known and frequently applied techniques to capture these characteristics are the autoregressive conditional heteroscedastic (ARCH) model proposed by Engle (1982) and its extension, the Generalized ARCH; (GARCH) model developed independently by Bollerslev (1986), and Taylor (1986). By assuming that Saudi stock market returns exhibit the phenomena of volatility clustering and leverage effect, this paper makes use of both symmetric (GARCH) and asymmetric (ECHARCH) models.

The contribution of this paper is two-fold. First, it tries to provide an explanation of the Saudi stock market volatility by incorporating the effect of inflation on both returns and conditional volatility of the general market index. Second, it offers a methodological contribution to empirical study of Mofleh (2011) by investigating the impact of inflation on stock market volatility not only under the symmetric effect but also by taking into account the asymmetric relationship (leverage effect) that describes how a negative shock causes volatility to rise more than if a positive shock with the same magnitude had occurred.

The rest of the paper is organized as follows: Section 2 provides an overview of the main characteristics of Saudi stock market along with describing some features of inflation rate during the period of the study. Section 3 presents the data, while section 4 briefly describes the methodology used. Empirical results are presented in Section 5. Finally, Section 6 concludes the paper.

Overview of Saudi Stock Market

The existence of Saudi stock market (SSM) dates back to the 1970s when it used to operate informally. In 1984, a Ministerial Committee comprising of the Ministry of Finance, Ministry of Commerce, and SAMA (Note 7) was formed to regulate the market. SSM which is known locally by its Arabic name *Tadawul* is the only market in Saudi Arabia. The market has several unique characteristics that differentiate it from other stock markets in the world. Share-trading activity is executed through commercial banks that are responsible for the settlement of transactions between buyers and sellers. The market is also characterized by the absence of a bourse and independent market-makers.

The overall performance of the Saudi stock market is measured by the *Tadawul* All Share Index (TASI) (Note 8), TASI reached its peak on 25th of February 2006, when it closed at 20,635. It was severely affected by the 2008

global crisis, like all the stock markets all over the world, and saw below 4000. It is currently trading around 6300 points. TASI witnessed six major collapses during the years 1986, 1990, 1993, 1994, 1998, 2006, and 2008 (Mofleh, 2011). During these collapses, the TASI lost a tremendous amount of its value and wiped out tens of billions of Riyals. For example, in the collapse of 2006, the TASI lost 8,779 points or 53% of its value compared to its value in 2005. The total assets of investment funds in domestic and foreign currencies decreased by 52.8 billion Riyals (or 38.5%) to end at 84.2 billion Riyals at the end of 2006 (SAMA Annual Report, 2007). In the most recent collapse of 2008, the TASI closed at 4802.99 at the end of 2008 compared to 11,038 at the end of 2007, a decrease of 56%. As a result, the total assets of investment funds decreased by 30.3 billion Riyals (or 29%) to end at 74.8 billion Riyals (SAMA Annual Report, 2009). Accordingly, it is of great importance for economists and policy makers to explore and rethink the relationship between the Saudi stock market and a set of macroeconomic variables (collectively and/or individually). In this direction, the current paper tries to shed light on the impact of inflation on stock market returns and volatility.

The Saudi stock market currently lists 144 publicly traded companies divided into fifteen sectors (as of August 15, 2010), Financials and Basic Materials sectors are the dominant sectors, together accounting for around 70% of market capitalization. The biggest two companies by market share are Al RAJHI Bank and SABIC, a petrochemical producer, both of which command around 11% of the market. The trading activity of the Saudi stock market can be considered very active with respect to the value of shares traded, the number of executed transactions and market capitalization (See Table 1) which suggests an increase in investor confidence during this time period.

Table 1
Key Indicators of Saudi Stock Market Activity (2007-2011)

Year	Listed Companies	Value Traded	Market Capitalization	No. of Transactions	Shares Traded
2007	111	628,055.57	522,721.12	11343727	53,083.03
2008	127	483,122.22	246,809.85	11082545	54,441.98
2009	135	322,432.10	318,784.68	12197799	54,443.71
2010	146	192,445.39	353,419.01	16108992	31,555.34
2011	144	247,143.91	328,029.67	10356812	40,995.49

Source: Arab Monetary Fund annual Reports.

Today, the Saudi Stock Market is the largest not only in the Gulf Community Council (GCC) (Note 9) countries, but also in the entire Arab World. Based on market capitalization, the Saudi stock market ranks first in the Arab world with 319 billion U.S. dollars compared to an average of 65 billion dollars for the Arab countries participating in the Arab Monetary Fund Index (AMFI). Compared to the other Arab stock markets in the AMFI, the Saudi stock market had by far the largest market, with its value of shares traded amounting to 337 U.S. billion dollars in 2009 (See Table 2). The second largest stock market is the Kuwaiti stock market, at 104 billion U.S. dollars. Additionally, the Saudi stock market is active and relatively liquid compared to the other markets in the AMFI, as measured by market depth ratio, and the turnover ratio respectively. At the end of 2009, the depth of the Saudi Stock Market was 86% of GDP compared to an average of 57% of GDP for Arab share markets, and was one of the most liquid markets in the Arab world with a turnover ratio of 106% compared to an average of 54% for Arab share markets in 2009 (See Table 2).

Inflation Rate in Saudi Arabia

Inflation in the Kingdom of Saudi Arabia is measured through the consumer price index (CPI) which measures consumer prices, and the GDP deflator, which measures inflation in the whole of the domestic economy. The CPI is composed of hundreds of products, and is based on a 1999 index. Food and rental costs together account for around 44 percent of the total CPI. Around 10 percent of goods and services in the CPI are subsidized by the authorities, primarily petroleum products and electricity. The prices of these goods are fixed for long periods, and therefore rarely have any impact on changes in the CPI. For these reasons, there is no distinction made between headline and “core” inflation, which excludes food and energy prices. The average inflation rate was kept very low at around 1%, in the eighties and nineties as a result of a weak oil market which had caused the oil revenues to decline. However, the rate of inflation has accelerated since 2003. From 2003 until 2010, the average annual inflation rate was 3.44 percent reaching an historical high of 11.08 percent in July of 2008 and a record low of 0.00 percent in September of 2004. In the latest data released by the Saudi Arabia Central Department of Statistics, inflation rates during the year ending September 2011 rose by 5.1 percent on an annual basis compared to the average inflation rate of 4.9 percent during the preceding five years (October 2005-September

Table 2
Key Indicators of Arab World Share Markets, End of 2009

Capital Market	No. of Listed Companies	Market* Capitalization	Ratio to Total (%)	Value of Shares Traded*	Market Depth	Turnover Ratio
Saudi Arabia	135	318,803	35.29	337.070	86.3	105.7
Kuwait	205	93,824	10.38	103.772	73.5	110.6
Egypt	306	91,092	10.8	81.173	48.1	89.1
Qatar	44	87,930	9.73	25.317	106.8	28.8
Abu Dhabi	67	80,201	8.88	18.766	35.7	23.4
Morocco	73	74,186	8.21	16.226	80.0	21.9
Dubai	67	58,095	6.43	47.239	25.8	81.3
Jordan	272	31,889	3.53	13.641	105.8	42.8
Oman	120	23,616	2.61	5.905	44.5	25.0
Bahrain	49	16,263	1.80	473.0	75.2	2.9
Lebanon	11	12,843	1.42	1.038	39.9	8.1
Tunisia	52	9,237	1.02	1.360	24.5	14.7
Sudan	53	3,033	0.34	1.006	5.5	33.2
Palestine	39	2,377	0.26	500.0	Na.	21.0
Algeria	2	91	0.01	187.5	0.1	206.1

* Millions of U.S. dollars.
Source: Quarterly Bulletin, Arab Monetary Fund, 2009.

2010) this is mainly due to higher food and housing costs.

Numbers of factors are expected to be contributing to inflation in the country. One of the reasons for rise in price level, as postulated by Sultan (2011), is the Riyal's fixed exchange rate with the US dollar. Since 1986 Saudi Arabia linked its currency with US dollar. This has also benefited the country on account of relative stability of US monetary policy and insulating the oil revenue in the budget from the exchange rate volatility, and stabilized the value of assets as large part of oil revenue is invested in dollar denominated assets. However, the weakening of the dollar since 2006 against euro and other currencies is now affecting the country in many ways. One of the fallouts of the fixed exchange rate is the soaring inflation in the country. The depreciation of the dollar relative to the Euro and other currencies means depreciation of the Riyal to these currencies. The direct effect of this is that it makes import from these countries costlier than be-

fore. As Saudi to a large extent depends upon import in absence of sufficient domestic production, and imports from the USA constitute less than 15 percent of Saudi's total imports, the rise in import prices causes a rise in the price level in the country.

Data Description

The data used in this paper consists of monthly observations of the stock market index and inflation rates over the period of January 1990 to December 2011, resulting in a total of 264 observations. The data series of the stock market index have been taken from the Saudi Stock Market website (http://www.tadawul.com.sa) while, inflation data has been taken from the Saudi Arabian Monetary Agency website (http://www.sama.gov.sa).

In this paper, volatility is defined as the variance of stock returns, so the data has been transformed into stock returns using logarithmic transformation such as:

$$r_t = \log\left(\frac{P_t}{P_{t-1}}\right) \qquad (1)$$

where r_t is the return of the index at time t. P_t and P_{t-1} are the market index at the current and previous month respectively. Summary statistics for the behavior of stock returns series and inflation rates are presented in Table 4.

An examination of characteristics displayed in Table 4 show that the average monthly stock returns are positive. The results also indicate that the TASI returns series and inflation rates do not conform to the normal distribu-

Table 3
Annual inflation rates in Saudi Arabia (percent)

	2006	2007	2008	2009	2010	2011
Food and beverages	5.4	7.0	14.1	2.0	6.2	5.8
Fabrics, clothing & footwear	-0.7	-2.4	0.4	0.5	-0.7	-0.2
Housing & related items	0.8	8.1	17.5	14.1	9.5	7.7
Home furniture	0.3	1.3	7.7	8.5	2.8	-0.3
Medical care	1.3	4.2	5.0	0.7	0.4	1.2
Transport & telecoms	-3.2	-0.9	0.2	1.0	1.1	2.1
Education and entertainment	0.3	0.2	2.1	1.3	0.9	0.9
Other expenses & services	7.7	5.3	10.7	4.3	7.4	8.0
Total	2.2	4.1	11.1	5.1	5.3	4.8

Source: complied by the author from Jadwa investment

Table 4
Summary Statistics for Stock Returns and Inflation in Saudi Stock Market

	Stock Returns	Inflation
Sample Period	1990M1 - 2011M12	1990M1 - 2011M12
Mean	0.006751	1.994126
Median	0.005313	1.085974
Minimum	-0.297753	-3.548616
Maximum	0.295428	11.13208
Standard Deviation	0.060061	2.961134
Skewness	0.642451	0.857965
Kurtosis	9.339150	3.477086
Jarque-Bera	458.4507	34.89228
Probability	0.000000	0.000000

tion but display positive skewness (the distribution has a long right tail), in addition to that, a highly leptokurtic distribution is also observed (Kurtosis values are greater than that related to normal distribution; 3). The Jarque-Bera (JB) statistic confirms that normality is rejected at a p-value of almost 1%. These results are consistent with the findings of several studies in both developed and developing markets. For example, Fama (1965) and Campbell, Lo and Mackinlay (1997) suggest strong deviations from the normal distribution of both daily and monthly returns of U.S. stock indexes. Bekaert, et al. (1998) provide evidence that 17 out of 20 emerging countries examined had positive skewness, and 19 out of 20 had excess kurtosis, so that normality was rejected for the majority of the sample countries. The monthly stock market index, returns and inflation rate for the period under review are presented graphically in Figure 1 and Figure 2 respectively.

Econometric Methods

The empirical investigation of this paper is conducted by means of the Generalized Autoregressive Conditional Heteroscedastic models including both symmetric and asymmetric models that capture the most common stylized facts about index returns such as volatility clustering and leverage effect. In presenting these models, there are two distinct specifications, the first for the conditional mean and the other for the conditional variance. The models are estimated using maximum likelihood method as in Bollerslev and Wooldridge (1992) (Note 10) under the assumption of Gaussian normal distribution (Note 11). The log likelihood function is maximized using Marquardt numerical iterative algorithm to search for optimal parameters.

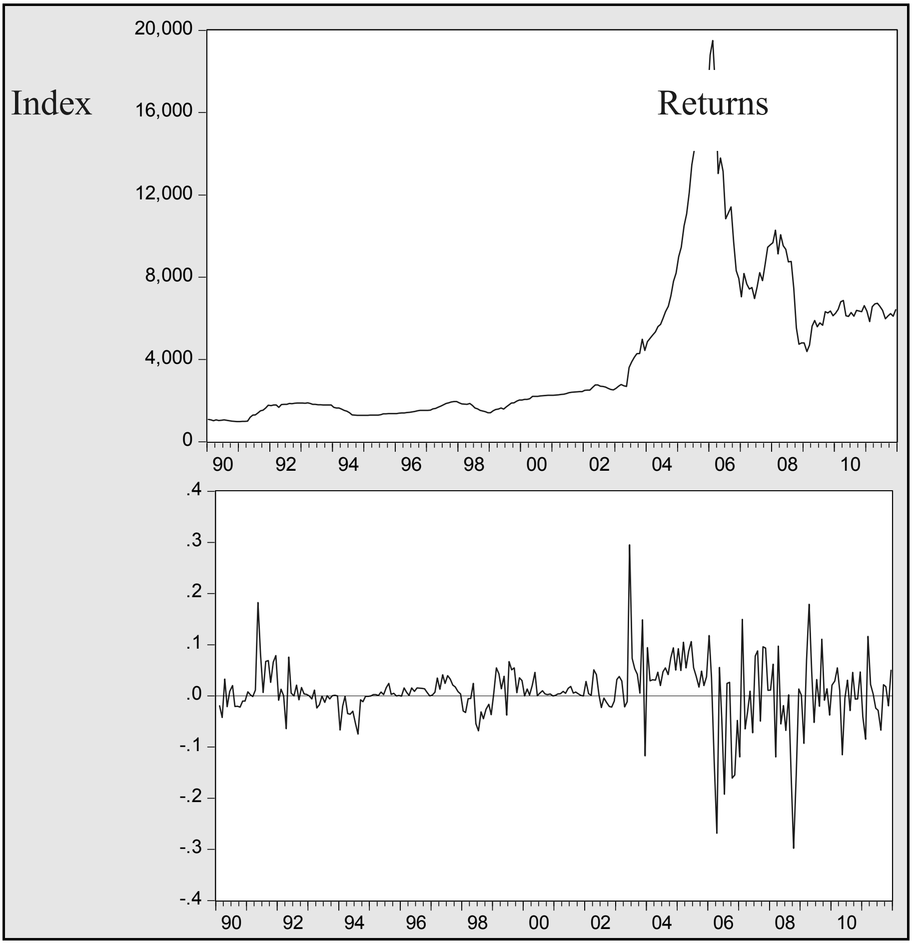


Figure 1: Saudi Arabia Monthly Stock Market Index and its Returns Jan. 1990 - Dec. 2011

The Generalized Autoregressive Conditional Heteroscedastic (GARCH) Model

The Generalized Autoregressive conditional heteroscedastic (GARCH) model is used in this paper to investigate the volatility clustering and persistence. The model has only three parameters that allow for an infinite number of squared errors to influence the current conditional variance (volatility). The mode was developed independently by Bollerslev (1986), and Taylor (1986). The conditional variance determined through GARCH model is a weighted average of past squared residuals. However, the weights decline gradually but they never reach zero. Essentially, the

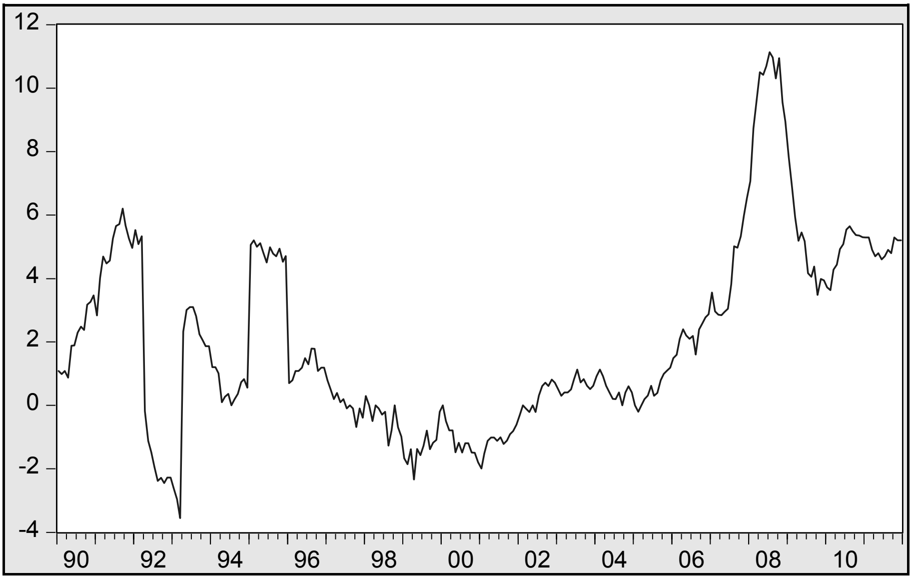


Figure 2: Saudi Arabia Monthly Inflation Rate Jan. 1990 - Dec. 2011

GARCH model allows the conditional variance to be dependent upon previous own lags.

In this paper, the following simple specification - GARCH (1,1) - is used:

Mean equation $r_t = \mu + \varepsilon_t$ (2)

Variance equation

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (3)$$

where $\omega > 0$ and $\alpha_1 \geq 0$ and $\beta_1 \geq 0$, and.

$r_t =$ return of the asset at time t.

$\mu =$ average return.

$\varepsilon_t =$ residual returns, defined as:

$$\varepsilon_t = \sigma_t z_t \quad (4)$$

where z_t is standardized residual returns (i.e. iid random variable with zero mean and variance 1), and σ_t^2 is conditional variance.

The constraints $\alpha_1 \geq 0$ and $\beta_1 \geq 0$ are needed to ensure σ_t^2 is strictly positive (Poon, 2005).

In this model, the mean equation is written as a function of constant with an error term. Since σ_t^2 is the one - period ahead forecast variance based on past information, it is called the conditional variance. The conditional variance equation specified as a function of three terms: (i) A constant term: ω ; (ii) News about volatility from the previous period, measured as the lag of the squared residuals from the mean equation: ε_{t-1}^2 (the ARCH term); and (iii) Last period forecast variance: σ_t^2 (the GARCH term).

The conditional variance equation models the time varying nature of volatility of the residuals generated from the mean equation. This specification is often interpreted in a financial context, where an agent or trader predicts this period's variance by forming a weighted average of a long term average (the constant), the forecast variance from last period (the GARCH term), and information about volatility observed in the previous period (the ARCH term). If the asset return was unexpectedly large in either the upward or the downward direction, then the trader will increase the estimate of the variance for the next period.

The Exponential GARCH (EGARCH) model

Even if the GARCH models successfully capture the thick tail returns, and the volatility clustering, they are poor models if one wishes to capture the leverage effect since the conditional variance is a function only of the magnitudes of the past values and not their sign. In financial time-series, it has been stated that volatility behaves differently depending on if a positive or negative shock occurs. This asymmetric relationship is called leverage effect, and describes how a negative shock causes volatility to rise more than if a positive shock with the same magnitude had occurred. To capture this asymmetry, different models have been developed and the one used in this paper is the simple EGARCH(1,1) model. This model captures asymmetric responses of the time-varying variance to shocks and, at the same time, ensures that the variance is always positive. This model was developed by Nelson (1991).

In macroeconomic analysis, financial markets and corporate finance, a negative shock usually implies bad news, leading to a more uncertain future. Consequently, for example, shareholders would require a higher expected return to compensate for bearing increased risk in their investment (Wang, 2003). This model has the following specification:

Mean equation

$$r_t = \mu + \varepsilon_t \tag{5}$$

Variance equation

$$Ln(\sigma_t^2) = \omega + \beta_1 Ln(\sigma_{t-1}^2) + \alpha_1 \left\{ \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| - \sqrt{\frac{2}{\pi}} \right\} - \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \tag{6}$$

The EGARCH model is asymmetric because the level $|\varepsilon_{t-1}|/\sigma_{t-1}$ is included with coefficient γ_1. Since this coefficient is typically negative, positive returns shocks generate less volatility than negative returns shocks assuming other factors remains unchanged.

Models to be estimated

Considering the discussion in the previous section, this paper investigates the impact of inflation on both returns and conditional variance equations, by using two different Generalized Autoregressive Conditional Heteroscedastic (GARCH) specifications.

Model 1: The impact of inflation on conditional volatility using GARCH model

The first model is the GARCH (1,1) of the following form:

Mean equation

$$r_t = \mu + \varepsilon_t \tag{7}$$

Variance equation

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \lambda INF_{t-1} \tag{8}$$

where INF represents the rate of inflation.

Model 2: The impact of inflation on conditional volatility using EGARCH model

In the second model, the paper makes use of the EGARCH(1,1) model. In which, the inflation variable is included into the variance equation such as:

Mean equation

$$r_t = \mu + \varepsilon_t \tag{9}$$

Variance equation

$$Ln(\sigma_t^2) = \omega + \beta_1 Ln(\sigma_{t-1}^2) + \alpha_1 \left\{ \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| - \sqrt{\frac{2}{\pi}} \right\} - \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \lambda INF_{t-1} \tag{10}$$

The coefficient of the inflation rate in all previous specifications measures the predictive power of previous inflation rates on stock market returns and volatility.

Empirical Results

The impact of inflation on conditional mean equation (only):

Table 5 reports the results of estimating the conditional mean and the conditional variance equations of the AR(1)-GARCH(1,1) and AR(1)-EGARCH(1,1) models.

Several conclusions can be drowning from the results in Table 5. The mean equation of the estimated AR(1)-GARCH(1,1) model shows that the coefficient related to AR(1) term θ is significant for all models (whether inflation included or not), this indicates that the previous period returns play a significant role in determining the current stock market returns. The estimated coefficients of the variance equation are statistically significant and with expected signs. The significance of α and β indicates that, lagged conditional variance and lagged squared disturbance have an impact on the conditional variance, in other words this means that news about volatility from the previous periods have an explanatory power on current volatility. As seen from Table 5, the estimated coefficient of

Table 5
Results of the impact of inflation on conditional mean only

Coefficients				
	Inflation not included	**Inflation included**	**Inflation not included**	**Inflation included**
	GARCH (1,1)	GARCH (1,1)	EGARCH (1,1)	EGARCH (1,1)
Mean Equation				
Constant (μ)	0.021627*	0.012297**	0.007542**	0.007142**
AR(1) (θ)	0.295814***	0.296122***	0.185793**	0.183635**
Inflation (λ)	-	-0.000802	-	0.000454
Variance Equation				
Constant (ω)	0.000260***	0.000285***	-0.753653***	-0.750811***
ARCH (α)	0.240657***	0.254212***	0.456423***	0.459574***
GARCH (β)	0.715325***	0.696187***	0.923018***	0.924105***
Asymmetric (γ)	-	-	-0.138475***	-0.140230***
Persistent ($\alpha + \beta$)	0.955982	0.950399	-	-

Notes: ***, **, * Denotes significance at the 1%, 5% and 10% level respectively.

the inflation rate is not statistically significant for all estimated models. Moreover, Table 5 shows that; the sum of the two estimated ARCH and GARCH coefficients $\alpha + \beta$ (persistence coefficient) in the GARCH (1,1) is very close to one which is required to have a mean reverting variance process, indicating that volatility shocks are quite persistent. The estimated GARCH coefficient in in the two GARCH and EGARCH models is lower when inflation included than the case of not taking inflation rate into account.

The impact of inflation on conditional volatility (only):

Table 6 reports the results of estimating the conditional mean and variance equations of the AR(1)-GARCH (1,1) and AR(1)-EGARCH(1,1)models.

Now, inflation rate has a significant effect on the conditional volatility for the two models implying that an increase in inflation rate in the previous period increases conditional market volatility for this month. This result is consistent with that of Cagan (1974) and Choudhry (1998).

Table 6
Results of the impact of inflation on conditional variance only

Coefficients				
	Inflation not included	**Inflation included**	**Inflation not included**	**Inflation included**
	GARCH (1,1)	GARCH (1,1)	EGARCH (1,1)	EGARCH (1,1)
Mean Equation				
Constant (μ)	0.011627**	0.014527***	0.007542**	0.008633*
AR(1) (θ)	0.295814***	0.163032**	0.185793**	0.186696**
Inflation (λ)				
Variance Equation				
Constant (ω)	0.000260***	0.000641***	-0.753653***	-1.192916***
ARCH (α)	0.240657***	0.175584***	0.456423***	0.520381***
GARCH (β)	0.715325***	0.536747***	0.923018***	0.869438***
Asymmetric (γ)	-	-	-0.138475***	-0.129946***
Inflation (λ)	-	0.000222***	-	0.033480***
Persistent ($\alpha + \beta$)	0.955982	0.712331	-	-

Notes: ***, **, * Denotes significance at the 1%, 5% and 10% level respectively.

The impact of inflation on both conditional mean and conditional volatility:

The results of investigating the impact of inflation rate on both mean and variance equations are presented in Table 7.

As in the previous estimations, no inflation effect is found on the conditional mean returns of the general market index. The only effect of inflation that can be seen from the results in Table 7 is that the estimated GARCH coefficient is much lower when including the inflation rate. For the conditional variance equation, the results indicate that the inflation rate has a significant positive effect.

Conclusions

This paper tries to shed light on the impact of the inflation rate on stock market returns and conditional volatility for the Kingdom of Saudi Arabia. The data used in this paper consists of monthly observations of the stock market index and inflation rates over the period of January 1990 to Decem-

Table 7
Results of the impact of inflation on both mean and conditional variance

Coefficients				
	Inflation not included	**Inflation included**	**Inflation not included**	**Inflation included**
	GARCH (1,1)	GARCH (1,1)	EGARCH (1,1)	EGARCH (1,1)
Mean Equation				
Constant (μ)	0.019627*	0.014054***	0.007542**	0.007627**
AR(1) (θ)	0.295814***	0.134093*	0.185793**	0.186593**
Inflation (λ)	-	-0.000452	-	-1.17E-05
Variance Equation				
Constant (ω)	0.000260***	0.000596***	-0.753653***	-1.214507***
ARCH (α)	0.240657***	0.211772***	0.456423***	0.521905***
GARCH (β)	0.715325***	0.499881***	0.923018***	0.866396***
Asymmetric (γ)	-	-	-0.138475***	-0.129818***
Inflation (λ)	-	0.000209***	-	0.034301**
Persistent ($\alpha + \beta$)	0.955982	0.711653	-	-

Notes: ***, **, * Denotes significance at the 1%, 5% and 10% level respectively.

ber 2011.The study employs the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) methodology including both symmetric and asymmetric models.

The empirical results of the paper find that there is no inflation effect on the conditional mean equation of the returns of the general market index. But, when investigating its effect on the conditional volatility, the results provide significant effect for the two models implying that an increase in inflation rate in the previous period increases conditional market volatility this period.

The paper concludes that, the only effect of inflation can be seen for the conditional variance equation that represents the volatility of Saudi stock market.

The results of the asymmetric GARCH models in this paper have important implications for investors in the Saudi stock market. They should look at the returns volatility (as a proxy for risk) revealed by the inflation rate when structuring port-

folios and diversification strategies. Finally, further research on the impact of inflation on returns for different firms and sectors of the Saudi stock market will be useful.

Notes

1 - According to the Fisher hypothesis there should be a one-to-one effect of expected inflation on nominal rates of returns, leaving real rates of returns independent of nominal returns. And, if there is a negative relationship between inflation and stock returns then investors would be vulnerable to inflation (Sari and Soytas, 2005).

2 - There is consensus among economists that the relationship between inflation and real output is negative, but stock market prices and real output are positively related.

3- A negative relationship between the two variables implies that investors whose real wealth is diminished by inflation can expect this effect to be compounded by a lower than average return on the stock market.

4- This means large changes tend to be followed by large changes and small changes tend to be followed by small changes (Mandelbrot, 1963). One theoretical explanation for clustered volatility is that at the beginning of each period new information leads to higher volatility associated with large returns (Kirchler and Huber, 2007).

5- This means large changes tend to be followed by large changes and small changes tend to be followed by small changes (Mandelbrot, 1963).

6- A time series is said to be homoscedastic if its variance is constant over time, otherwise it is called heteroscedastic.

7- The Saudi Arabia Monetary Agency (SAMA) was responsible for supervising the market from 1984 until 2003. In July 2003, authority was handed over to the newly formed Capital Market Authority (CMA). The CMA is now the sole regulator and supervisor of Saudi Arabia's capital markets, and issues the necessary rules and regulations to protect investors and ensure fairness and efficiency in the market (Talat *et al.,* 2011).

8- The index was developed with a base value of 1000 in 1985 and it was restructured on 06/30/08.

9- The Gulf Cooperation Council (GCC) consists of six Arab states, including Saudi Arabia, Kuwait, Bahrain, Qatar, the United Arab Emirates, and the Sultanate of Oman.

10- Maximum likelihood estimator (MLE) is the most popular method where parameters are chosen such that the probability of occurrence of data under its assumed density function is the maximum. MLE is widely used because it produces an asymptotically normal and efficient parameter estimates (Justin 2005).

11- There are three assumptions commonly employed in empirical work that adopts the GARCH model: the normal distribution, student's t-distribution, and the generalized error distribution (GED). In the presence of GARCH effects, as in our study, the more appropriate distribution of the data is the one that is able to match the kurtosis and skewness in the data. Following Mandelbrot (1963) and Fama (1965) who among others, suggested that stock returns are normally distributed.

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الملخص

تأثير التضخم على العوائد والتقلبات الشرطية لأسواق الأوراق المالية: دليل تطبيقي من المملكة العربية السعودية

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تهدف هذه الدراسة إلى التحقُّق من مدى تأثير معدلات التضخم على عوائد وتقلبات المؤشر العام لسوق الأوراق المالية بالمملكة العربية السعودية (تداول)؛ وذلك من خلال استخدام بيانات شهرية لأسعار إقفال مؤشر السوق ومعدلات التضخم للفترة من يناير ١٩٩٠ حتى ديسمبر ٢٠١١م. وتتضمن الطرق التطبيقية المستخدمة النماذج العامة لاختلاف التباين الشرطي المنحدر ذاتياً، متضمنة النماذج المتماثلة وغير المتماثلة. حيث تفيد نتائج الدراسة عدم معنوية تاثير معدلات التضخم في معادلة العوائد على مؤشر السوق، بينما تُظهر تأثيراً معنوياً موجباً للتضخم عند إدراجه في معادلة التباين الشرطي التي تعبر عن تقلبات مؤشر السوق.

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